



Stratospheric Aerosol and Gas Experiment SAGE III on ISS

An Earth Science Mission on the International Space Station

SAGE III Ozone Validation with NDACC Sondes

**NDACC Lidar Working Group Meeting: Huntsville, Alabama
May 11, 2018 Presented By: Susan Kizer¹**

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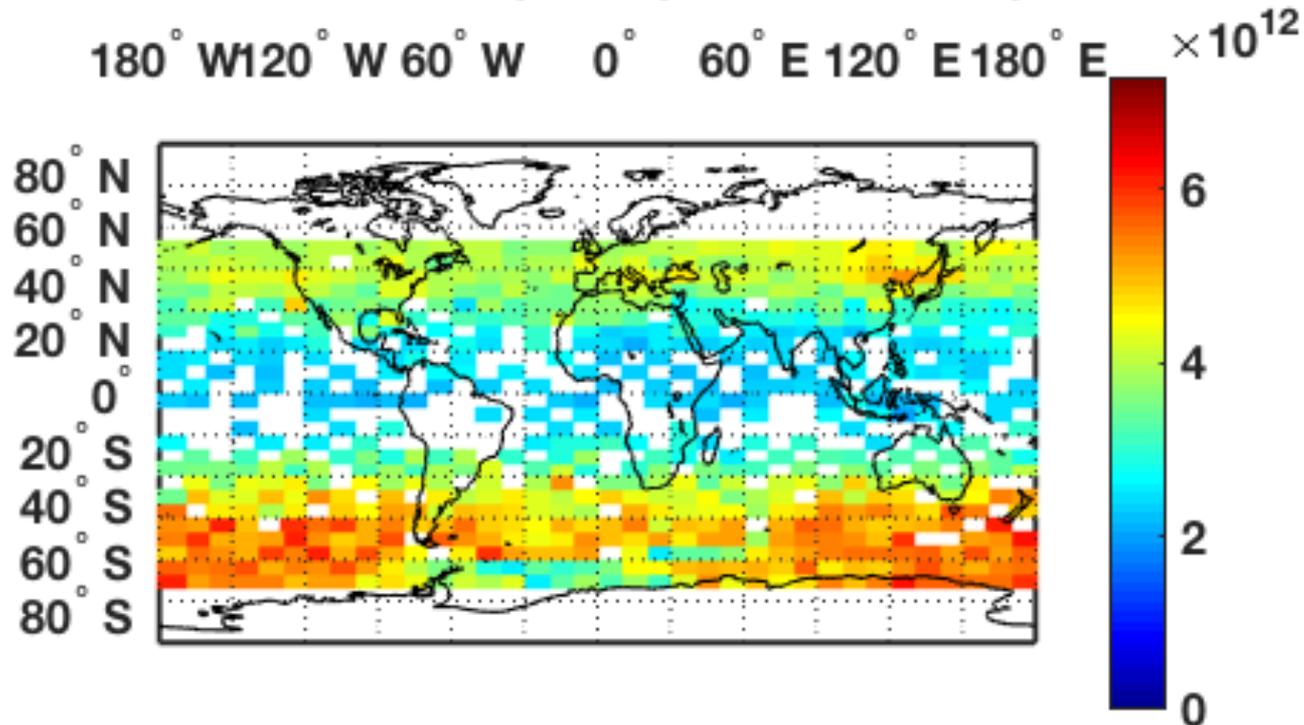
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SAGE III/ISS Global Coverage

**SAGE III/ISS Solar Events Zonal Mean
Ozone MLR Number Density @ 20km
October – December 2017**

Latitude Bin: 5 Deg.; Longitude Bin: 10 Deg.



- **More consistent coverage in upper and lower mid-latitudes**
- **Less coverage in tropics**
- **Does not take measurements > 70 degrees latitude**

NIWA Solar Events Matched to SAGE III/ISS Overpasses

SAGE III Solar Sunrise 20170814 19:02:29 -45.86 180.55
NIWA Ozonesonde Lauder, NZ 20170814 22:02:16 -45.04 169.68
 Distance = 852.2 km

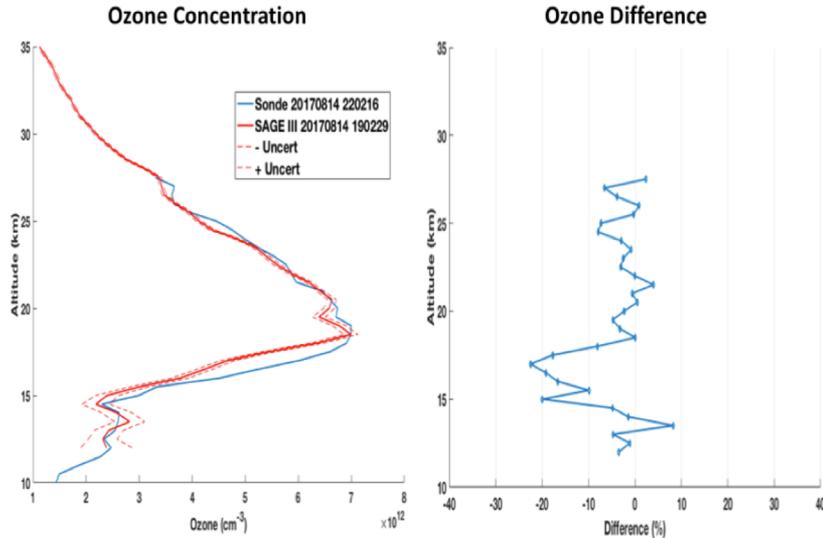


Figure 1. SAGE III Solar Sunrise MLR Ozone vs NIWA Aug. 14, 2017

NIWA Ozonesonde Lauder, NZ Nov.11,2017 07:59:12 Lat:-45.04 Lon:169.68
SAGE III/ISS Solar Sunset Nov.11,2017 08:12:18 Lat:-42.54 Lon:159.74
 Distance = 844.0 km

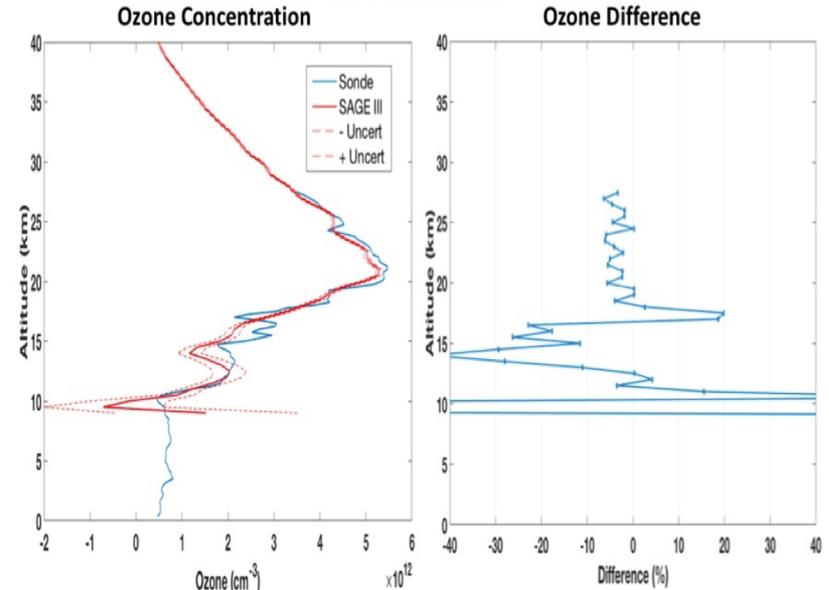


Figure 2. SAGE III Solar Sunset MLR Ozone vs NIWA Nov. 11, 2017

- The National Institute of Water and Atmospheric Research (NIWA) in Lauder, NZ planned ozonesonde launches to coincide with SAGE III/ISS overpasses.
- These figures show comparisons over Lauder, NZ for a Solar Sunrise and Solar Sunset event.
- Percent differences are calculated $(SAGE - \text{sonde})/\text{sonde} * 100$.
- Solar comparisons show agreement of SAGE III and ozonesondes within about a percent difference of 10% within the stratosphere.
- Data events are co-located using a best match of location and time.



NOAA ESRL Solar Events Matched to SAGE III/ISS Overpasses



SAGE III Solar Sunset 20171012 23:40:37 40.49 -95.3
NOAA Ozonesonde Boulder, CO 20171012 18:53:18 39.95 -105.2
Distance = 842.3 km

SAGE III Solar Sunset 20171210 22:43:44 41.40 -94.6
NOAA Ozonesonde Boulder, CO 20171211 19:22:30 39.95 -105.2
Distance = 907.7 km

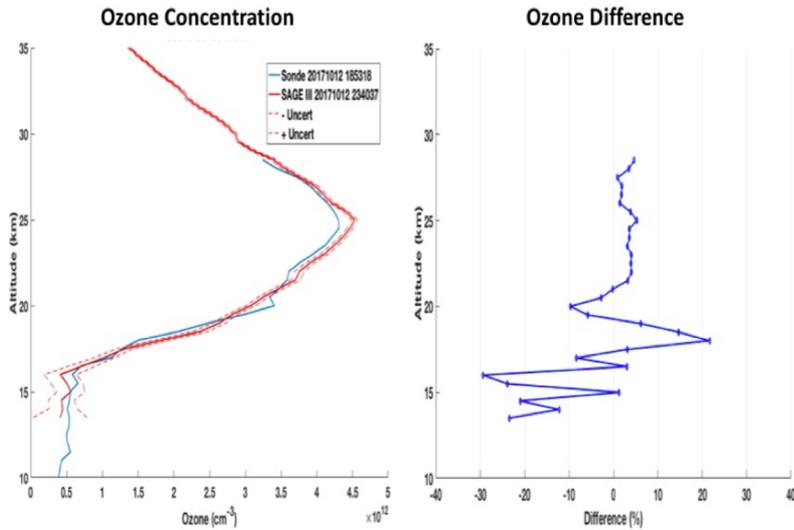


Figure 3. SAGE III Solar Sunset MLR Ozone vs NOAA ESRL Oct. 12, 2017

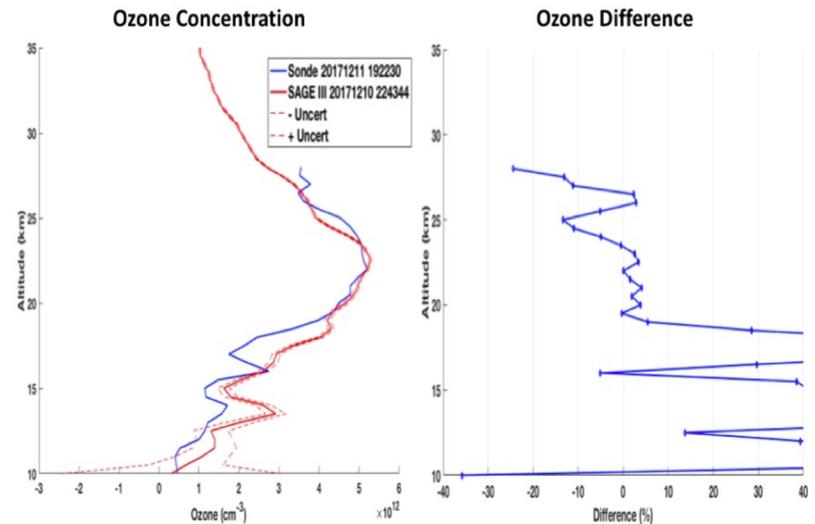


Figure 4. SAGE III Solar Sunset MLR Ozone vs NOAA ESRL Dec. 10, 2017

- The NOAA Earth System Research Laboratory (ESRL) in Boulder, CO planned ozonesonde launches to coincide with SAGE III/ISS overpasses.
- The figures show comparisons over Boulder for two Solar Sunset events.
- Percent differences are calculated $(\text{SAGE} - \text{sonde})/\text{sonde} * 100$.
- Solar comparisons show agreement of SAGE III and ozonesondes within about a percent difference of 10% within the stratosphere.
- Data events are co-located using a best match of location and time.

NIWA Lunar Event Matched to SAGE III/ISS Overpass

SAGE III Lunar Moonset 20171027 13:15:49 -42.1315 172.9711
 NIWA Ozonesonde Lauder, NZ 20171027 12:21:41 -45.0378 169.6838
 Distance = 418.03 km

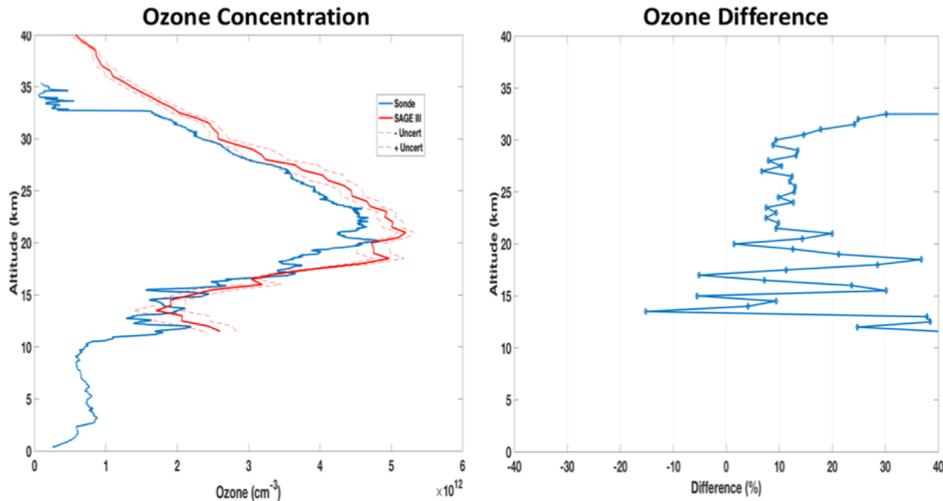


Figure 5. SAGE III Lunar Moonset MLR Ozone vs NOAA ESRL Oct. 27, 2017

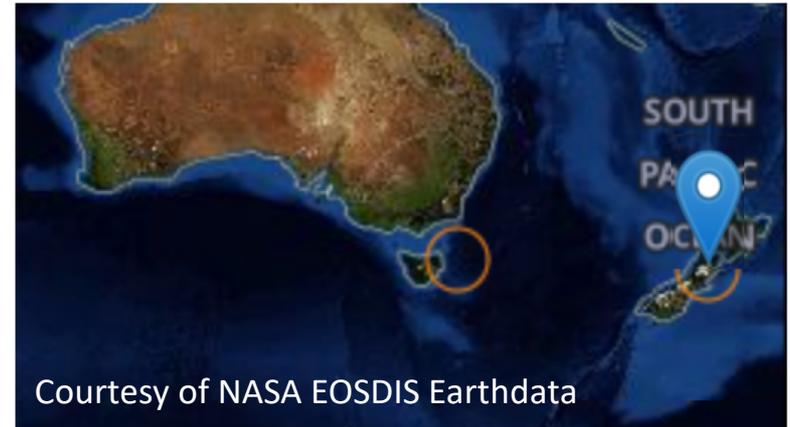


Figure 6. Map of SAGE III Lunar Events near Lauder on Oct. 27, 2017

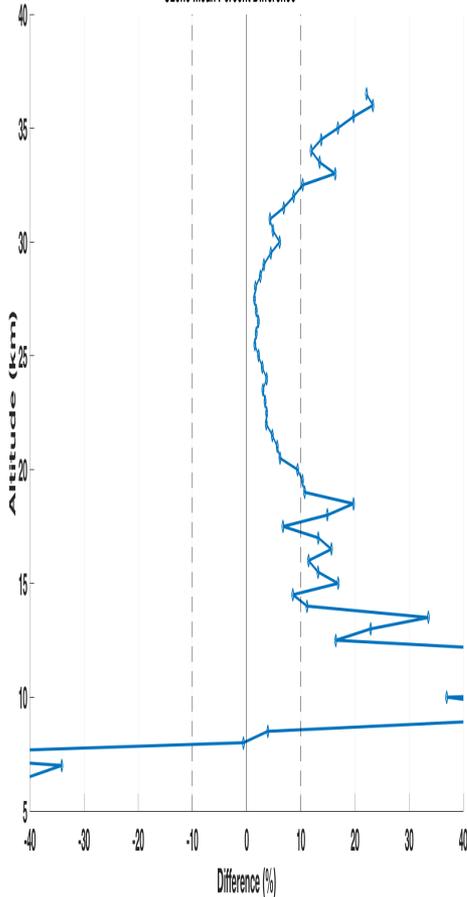
- Special thanks to the NIWA team for a nighttime balloon launch for a coincidence with a SAGE III lunar event.
- The figures to the left show a comparison of a Lunar Moonset over Lauder, NZ.
- Percent differences are calculated $(SAGE - sonde)/sonde * 100$.
- The Lunar comparison shows agreement within a percent difference of about 20% within the stratosphere.
- Data events are co-located using a best match of location and time.
- The NASA EOSDIS Earthdata tool for acquiring SAGEIII/ISS data was an asset in a visual co-location of events as seen in the map on the right. A red/orange circle shows two consecutive locations of SAGE III Lunar data events and the pointer shows the location of the NIWA station in Lauder. The comparison plots shown represent the match appearing over Lauder on the map.



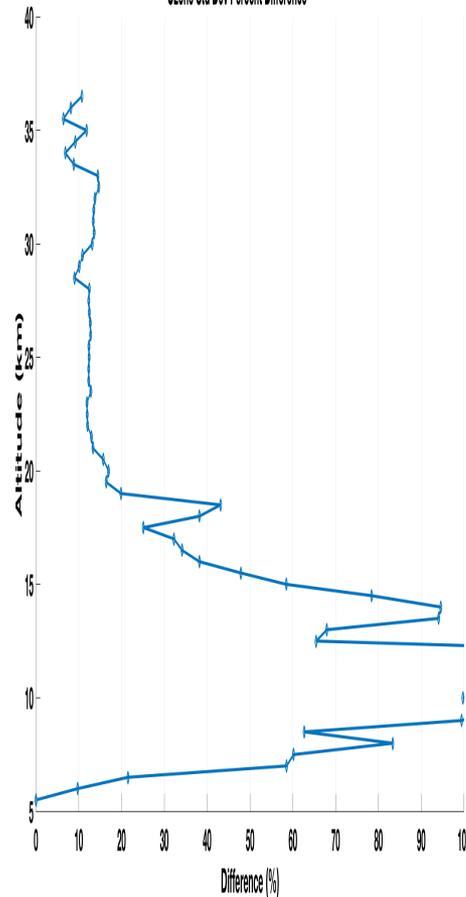
SAGE III/ISS Matched to NDACC Ozonesondes



SAGE III/ISS matched to NDACC Ozonesondes
 Lat Diff 5, Lon Diff 15, Time Diff 24:00:00
 Ozone Mean Percent Difference



SAGE III/ISS matched to NDACC Ozonesondes
 Lat Diff 5, Lon Diff 15, Time Diff 24:00:00
 Ozone Std Dev Percent Difference

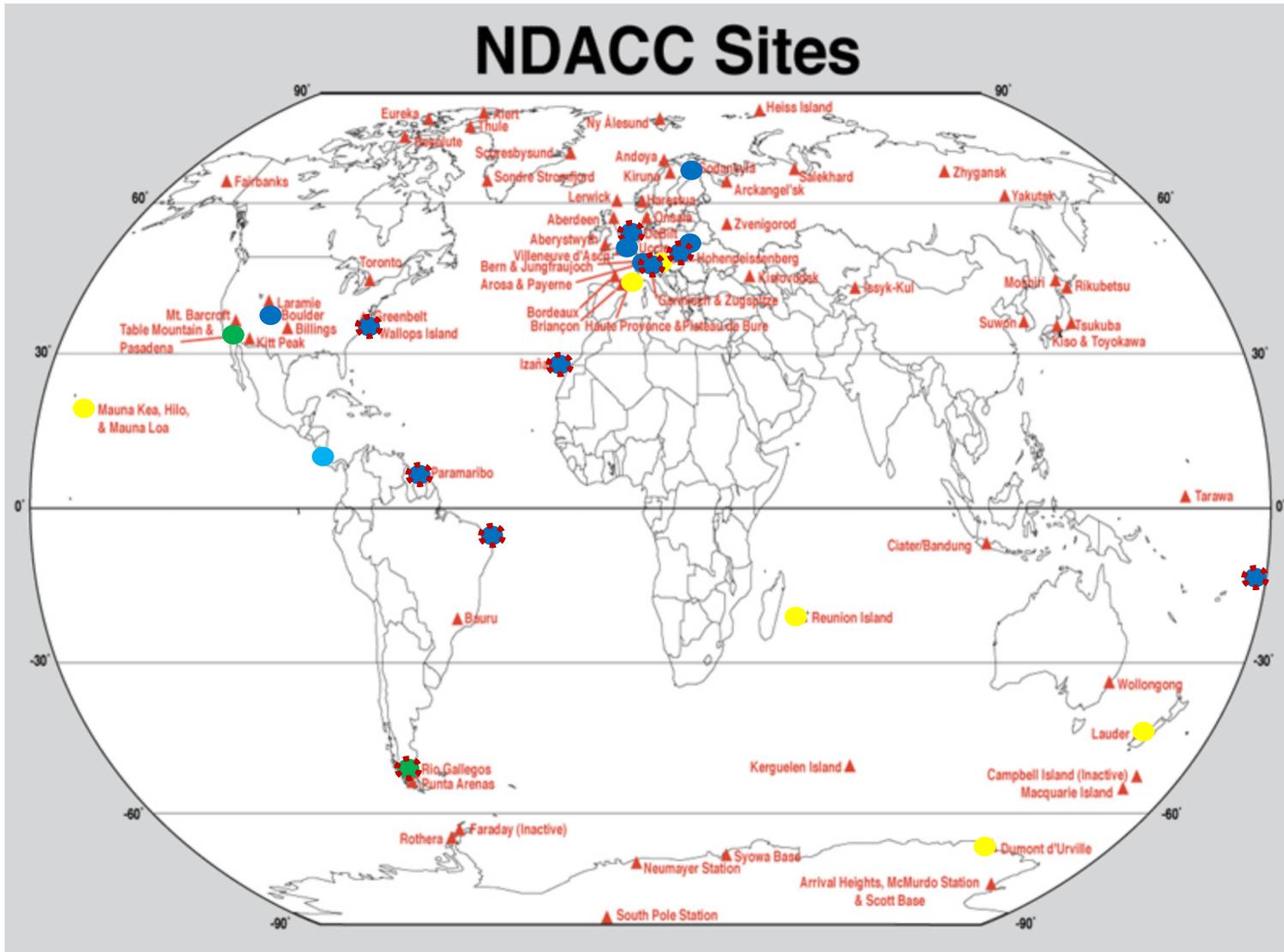


Lat Difference Max 5 Degrees
Lon Difference Max 15 Degrees
Time Difference Max 24 hours
NOTE: SAGE III/ISS Solar Events Only

57 Matches total:

Hohenpeissenberg	(48N, 11E)	31
Lauder	(45S, 170E)	5
Reunion, St Denis	(22S, 56E)	3
OHP	(44N, 6E)	2
Payerne	(47N, 7E)	13
Dumont d'Urville	(67S, 140E)	3

Potential SAGE Validation Sites



- Lidar and Sonde
- Lidar Only
- Sonde Only
- H2O Only
- ⊛ Not Current



SAGE III/ISS Validation Event Prediction Locator

<https://sage.nasa.gov/validation/>



- Step 1: Occultation type selector
- Step 2: Temporal range selector
- Step 3: Geospatial range selector (optional)

Example of Results:

POC: Carrie Roller

Occultation Type	Temporal constraints	Spatial constraints
<ul style="list-style-type: none">SunriseSunsetMoonriseMoonsetLimb	2018-05-05T00:00:00.000000Z to 2018-05-23T23:59:59.999999Z	-35.753910541534°N, -49.816410541534°S, 161.98825836182°W, -179.73049163818°E



Display 30 events Search:

Event ID	Cycle ID	Event Date	Occult type	Az	El	Lat	Lon	Solar Beta	Lunar Beta	LPhase	SZA	Altitude	ISS Orbit
1118320	20180429	2018-05-05 05:31:43	Sunset	177.87	-19.83	-47.25	167.88	2.00	-52.56	121.03	90.00	410.80	11183
1121420	20180506	2018-05-07 05:23:50	Sunset	167.98	-19.82	-46.35	169.72	11.30	-69.67	99.43	90.00	410.77	11214
1124520	20180506	2018-05-09 05:16:03	Sunset	157.81	-19.80	-44.33	172.33	20.81	-52.57	77.49	90.00	410.68	11245
1126120	20180506	2018-05-10 05:58:35	Sunset	152.48	-19.78	-42.76	162.38	25.77	-37.74	65.83	90.00	410.61	11261
1127620	20180506	2018-05-11 05:08:31	Sunset	147.44	-19.76	-40.88	175.76	30.43	-22.75	54.60	90.00	410.52	11276
1129220	20180506	2018-05-12 05:51:15	Sunset	142.03	-19.73	-38.35	166.26	35.39	-6.05	42.26	90.00	410.39	11292

Showing 1 to 6 of 6 entries

First Previous 1 Next Last



Summary



- **A first-look at the SAGE III/ISS Level 2 Multiple Linear Regression (MLR) ozone concentrations shows a good agreement with coincident measurements from NIWA, NOAA ESRL, and NDACC ozonesondes in the stratosphere.**
- **Special thanks to NOAA ESRL and NIWA for planning measurements with expected SAGE III/ISS overpasses. Especially to the NIWA team for a nighttime balloon launch that coincided with a SAGE III lunar event.**
- **Currently in the process of further investigation of ozone agreement stratified to mid-latitudes, tropics, polar regions, North, South, seasons, etc.**
- **Please take advantage of the SAGE III/ISS Validation Prediction Tool when planning LIDAR, ozonesonde, frost point hygrometer, etc. measurements.**